

Environmental Life Cycle Assessment of Gasoline Alternatives: MTBE and Ethanol Additives

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Life Cycle Assessment (LCA)

Capture the multimedia environmental effects of creating, using and disposing of a **functional unit**

Functional unit: an equally performing specific function

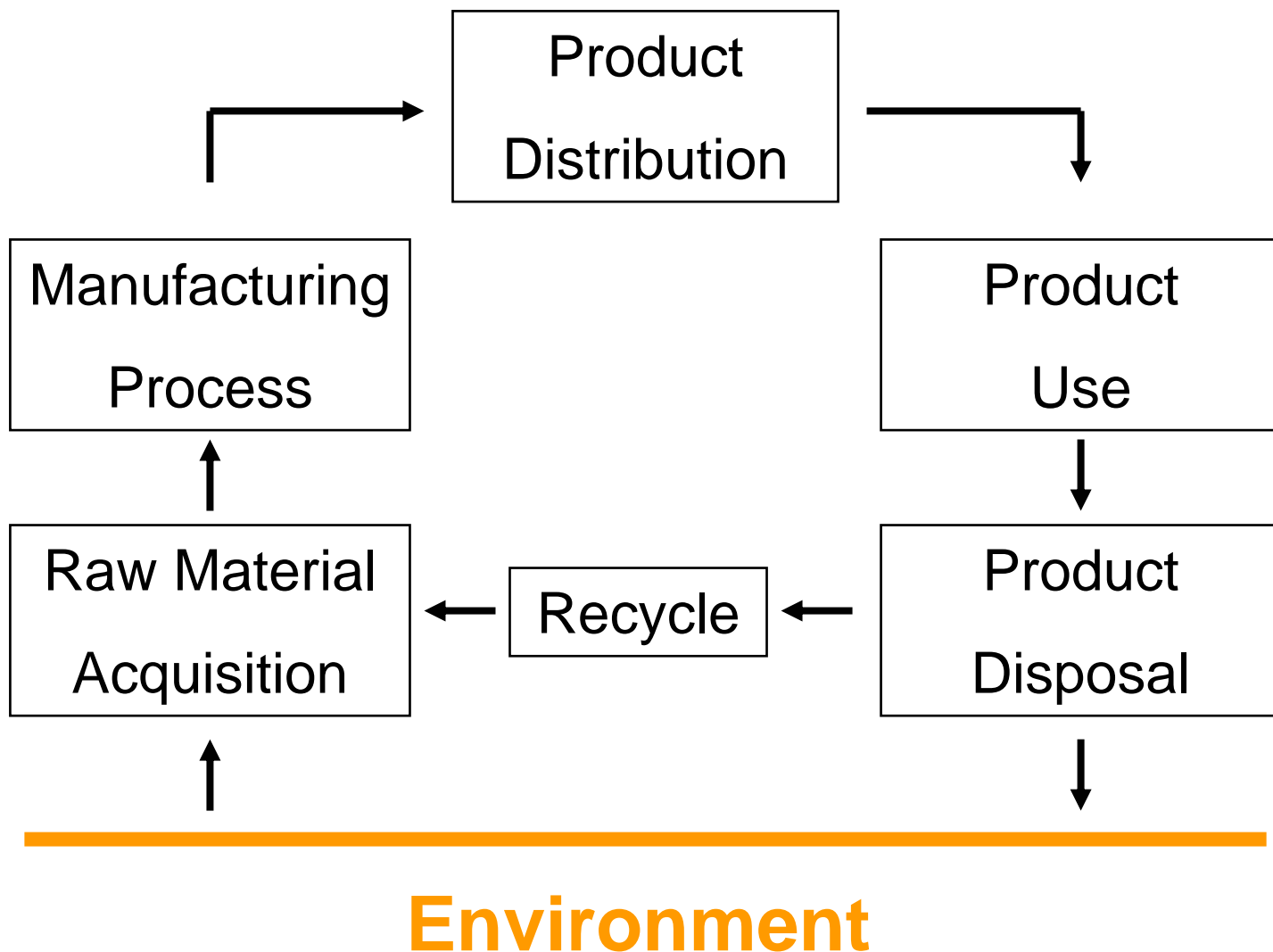
This work: one automobile traveling 12,000 miles. Results in different amounts of each gasoline alternative

Life Cycle Assessment (LCA)

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Cradle to grave analysis

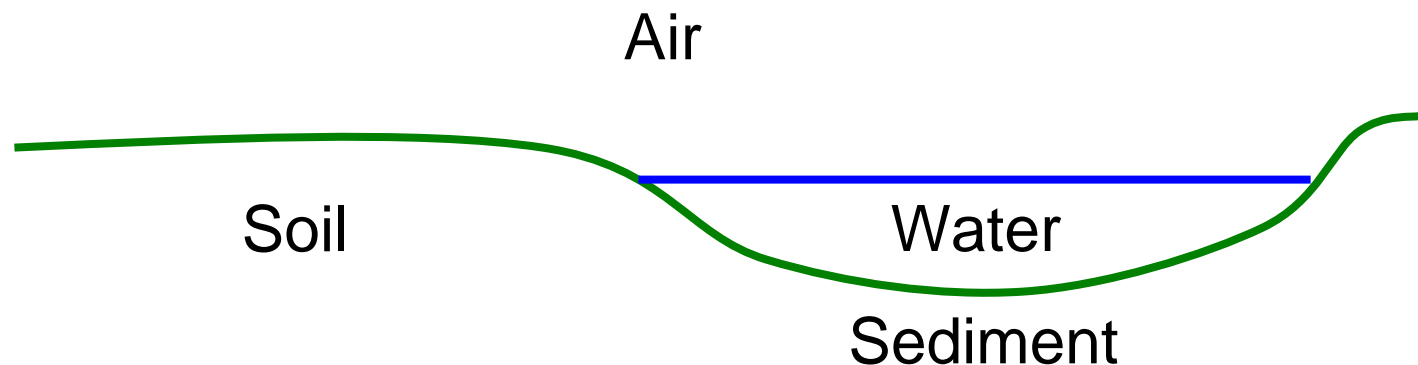
LCA Cradle to Grave Analysis



Life Cycle Assessment (LCA)

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Multimedia analysis



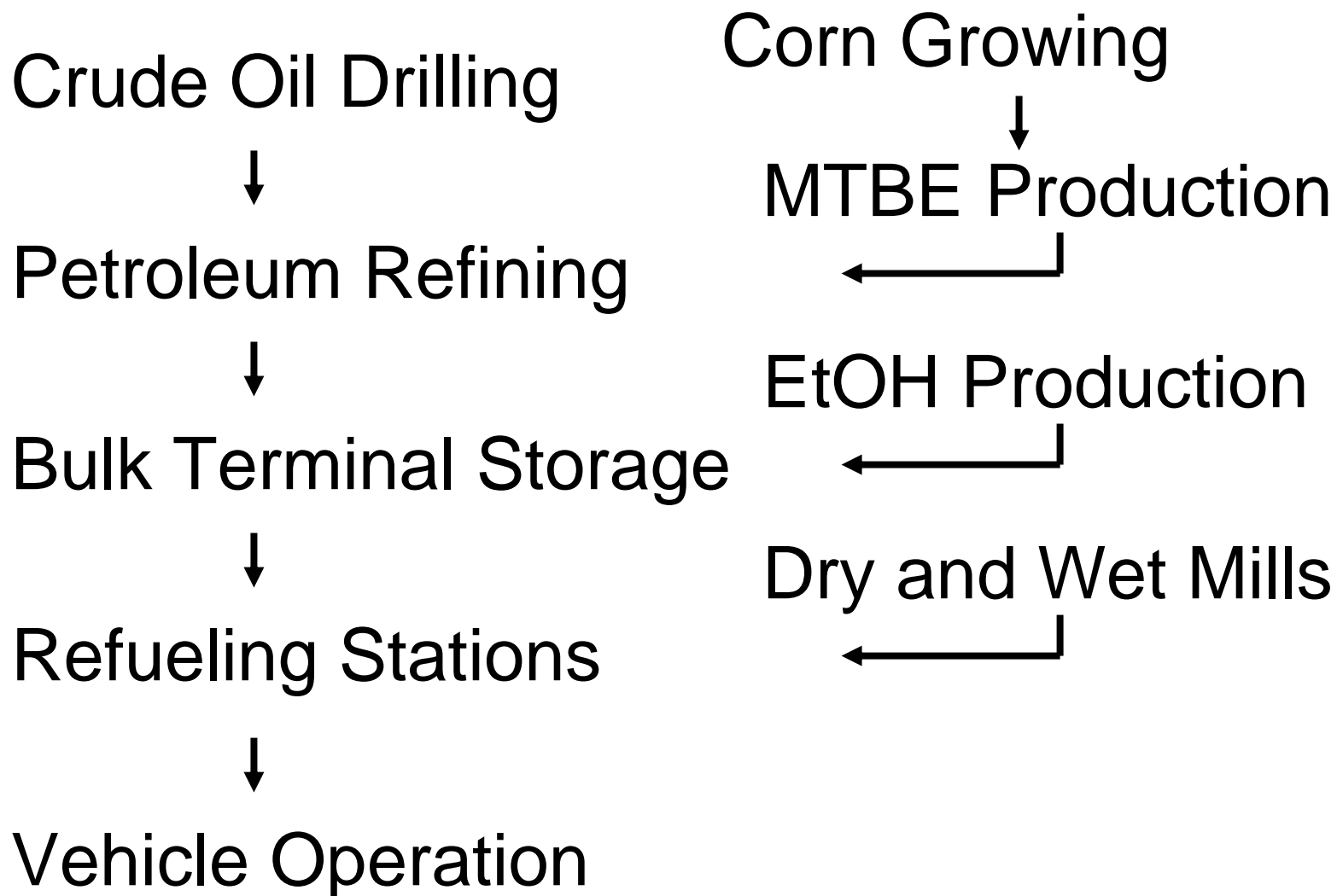
Inventory Approaches for LCA

Process chain vs. economic
input/output approach

Economic input/output approach uses
table of sector production and
demand

Difficulty associated with emissions is
that they (should) represent the
whole sector

Process Chain Approach for Gasoline Alternatives



Preliminary Total Inventory

lb air/yr	MTBE	EtOH	NonOxy
VOC	12	13	12
NOx	31	32	31
SOx	6.2	7.5	6.0
PM10	1.2	1.5	1.1
N2O	3.4E-02	9.1	3.3E-02
CO2	2000	1100	1900
Toxics	2300	880	830

Preliminary Raw Material Acquisition Inventory

lb air/yr	MTBE	EtOH	NonOxy
VOC	0.31	0.41	0.34
NOx	6.0	7.2	6.6
SOx	1.7	1.8	1.8
PM10	0.22	0.59	0.24
N2O	1.2E-02	9.1	1.4E-02
CO2	640	-460	700
Toxics	2.0	0.48	2.2

Preliminary Production Inventory

lb air/yr	MTBE	EtOH	NonOxy
VOC	1.8	1.6	1.7
NOx	5.1	4.7	4.1
SOx	4.4	5.5	4.0
PM10	0.26	0.26	0.22
N2O	2.2E-02	2.2E-02	1.9E-02
CO2	1300	1500	1200
Toxics	6.4	5.7	5.7

Preliminary Use Inventory

lb air/yr	MTBE	EtOH	NonOxy
VOC	10	10	10
NOx	20	20	20
SOx	0.16	0.16	0.16
PM10	0.67	0.67	0.67
N2O	8.5E-06	8.6E-06	8.3E-06
CO2	1.1	1.1	1.1
Toxics	2200	880	820

Preliminary Additive Production Inventory

lb air/yr	MTBE	EtOH
VOC	0.22	7.1E-03
NOx	1.1	0.67
SOx	0.66	1.7
PM10	5.0E-02	4.1E-02
N2O	3.6E-03	3.6E-03
CO2	200	350
Toxics	0.52	6.8E-02

What's Next?

Impact Assessment

Capture the multimedia environmental
effects of creating, using and
disposing of a functional unit

TRACI

Tool for the Reduction and Assessment of Chemical and other environmental Impacts (TRACI)

- Ozone Depletion
- Global Warming
- Smog Formation
- Acidification
- Eutrophication
- Human Health Cancer
- Human Health Noncancer
- HH Criteria Pollutants
- Eco-toxicity
- Fossil Fuel Depletion
- Land Use
- Water Use

J.C. Bare et al. (2002) *J. Industrial Ecology* 6(3-4), 49-78.

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Taxonomy of impacts